"Così il Pioppo nero della *Virginia* (*Spec.* I. *var.* β) sembrami una varietà del Pioppo nero d'Europa, benchè il Sig. *Fougeroux de Bondaroy* nelle Memorie della Società d'Agricoltura, che si stampano a Parigi, ne formi una nuova specie. Quest' albero s'innalza a settanta, ed ottanta piedi formando una cima rotonda, le sue foglie sono sostenute da lunghi picciuoli spesso tinti di rosso, e sono quasi a figura di cuore, scannellate al margine, e liscie da ambe le parti . . . ."

Leaves of an ovate type.

POPULUS DELTOIDES Bartr., Marsh. l. c.?

P. canadensis Moench, Weisenst. 81, 1785; Asch. & Graebn. Syn. **4**: 33, 1908.

? P. marilandica Bosc; Poir. in Lam. Enc. Suppl. **4**: 375, 1816.

Aigeiros deltoides Tm. l. c.

Similar in stature and form to the preceding: branchlets smooth, yellowish-brown: buds dark olive-brown, pointed; normal leaves 8–10 cm. in length, deltoid-ovate, base rounded; crenate-serrate to within 1 cm. of the apex; leaves of the root-shoots and uppermost branchlets 15 cm., more or less, in length, and as wide, base truncate: staminate aments about 1 dm. in length; stamens about 40, anthers dark red.

It is to be hoped that local botanists will take up the study of their native poplars so that we may know at least as much about our trees as is known in Europe. Concepts based on herbarium specimens alone often tend more to confuse than illuminate.

BUREAU OF PLANT INDUSTRY, Washington, D. C.

ON GYNODIOECISM IN PLANTAGO LANCEOLATA.

HARLEY HARRIS BARTLETT.

IN 1879 Franz Ludwig [1] published an account of the forms of the flower in *Plantago lanceolata,* in connection with a general discussion

[1] F. Ludwig: Ueber die Blütenformen von *Plantago lanceolata* L. und die Erscheinung der Gynodiöcie. Zeitschr. für die gesammten Naturwissenschaften, liii (1879), p. 441. Review in Bot. Centralb. i (1880), p. 331.

of gynodioecism. He called attention to the observation by Darwin [1] that in England there were two kinds of stocks of *Plantago lanceolata*, of which one had perfect and the other pistillate flowers. The flowers of the pistillate stocks did, indeed, bear anthers, but there was either no pollen at all or only a few imperfect grains of varying size. According to a communication from Delpino to Ludwig, there were in Italy three geographic varieties of *P. lanceolata*, of which one only, the early spring form of the meadows, was dimorphous. One form had broad white anthers with an abundance of pollen; the other broad green-yellow anthers with scanty pollen but regular dehiscence, still an hermaphrodite form, but verging toward the gynodioecious condition. In Germany, Ludwig himself found that all the habitat and geographic variations exhibited three flower forms: 1) the ordinary hermaphrodite, with long straight filaments bearing broad, roundish to heart-shaped white anthers containing plentiful pollen, 2) a form with short, crooked filaments bearing slender, green to sulphur-yellow irregularly dehiscent anthers, with abortive pollen, and 3) a purely pistillate form with no filaments and very small rudimentary yellow-green or brownish anthers. He thought that the second of these forms was identical with Darwin's "female form," but the descriptions do not agree well enough to establish their identity beyond question.

With regard to the relative frequency of the forms, Ludwig found that in general the second was much scarcer than the first, and that the third was much more infrequent than the second. He observed that the pistillate form was characterized by extreme fertility, whereas

[1] Darwin's own statement (Forms of Flowers, ed. 2, pp. 306-307) is as follows: "....But I have found in two localities in England female and hermaphrodite forms existing together, and the same fact has been noticed by others. (Mr. C. W. Crocker in 'The Gardener's Chronicle,' 1864, p. 294. Mr. W. Marshall writes to me to the same effect from Ely.) The females are less frequent than the hermaphrodites; their stamens are short, and their anthers, which are of a brighter green while young than those of the other form, dehisce properly, yet contain either no pollen, or a small amount of imperfect grains of variable size. All the flower heads on a plant belong to the same form. It is well known that this species is strongly proterogynous, and I found that the protruding stigmas of both the hermaphrodite and female flowers were penetrated by pollen tubes, whilst their own anthers were immature, and had not escaped out of the bud. *Plantago media* does not present two forms; but it appears from Asa Gray's description ('Manual of the Botany of the N. United States,' 2nd. edit. 1856, p. 269. See also 'American Journal of Science,' Nov. 1862, p. 419, and 'Proc. American Academy of Science,' Oct. 14, 1862, p. 53.) that such is the case with four of the North American species. The corolla does not properly expand in the short-stamened form of these plants."

the common hermaphrodite form often failed to produce seed. Another character which distinguished the intermediate and pistillate forms from the hermaphrodite was that the former produced greatly elongated stigmas far more frequently than the latter. This seemed to be due in part to the continued growth of the stigmas in pistillate plants whose pollination was delayed beyond the time at which a normal hermaphrodite would have been self-pollinated. In part, however, it seemed to be an inherited tendency of the pistillate stocks.

A. Schulz [1] established the fact that *Plantago lanceolata* is not only gynodioecious but also gynomonoecious. The flower spikes of gynomonoecious stocks bear both hermaphrodite and pistillate flowers, and intermediate types, in separate zones or variously intermingled.

The writer's attention was brought to the forms of *Plantago lanceolata* in the summer of 1910 through finding in his experiment garden at Bethesda, Maryland, a single plant with bright yellow sagittate anthers. This plant was unique, for an examination of thousands of specimens of the species in the surrounding fields failed at the time to disclose another like it. However, the search brought to light many purely pistillate plants, which formed no inconsiderable proportion of the total number, and a great variety of gynomonoecious forms. At the time the yellow-anthered form was found, the Plantago had been in flower only a short time. Since then the greater part of the season of 1910 and the season of 1911 have passed without more than a half dozen such specimens having been found. Many times an identical anther form has been found on gynomonoecious stocks which were nearing the close of their season, and flowering only at the top of the spikes. Such plants never failed to show, however, the wilted remnants of broad white anthers like those of the pure hermaphrodite form.

For convenience the three chief forms of *Plantago lanceolata* which have been found about Washington will be called, in the remainder of this paper, the 1st and 2d form hermaphrodites and the pistillate form. They correspond to the three forms distinguished by Ludwig, although their numerical distribution is not the same here as in Germany. (It will be remembered that Ludwig found his intermediate form much more abundant than the pure pistillate.

[1] A. Schulz: Beiträge zur Kenntniss der Bestäubungeinrichtungen und Geschlechtsverteilung bei den Pflanzen. Biblioth. Bot., Heft 10 (1888) p. 90.

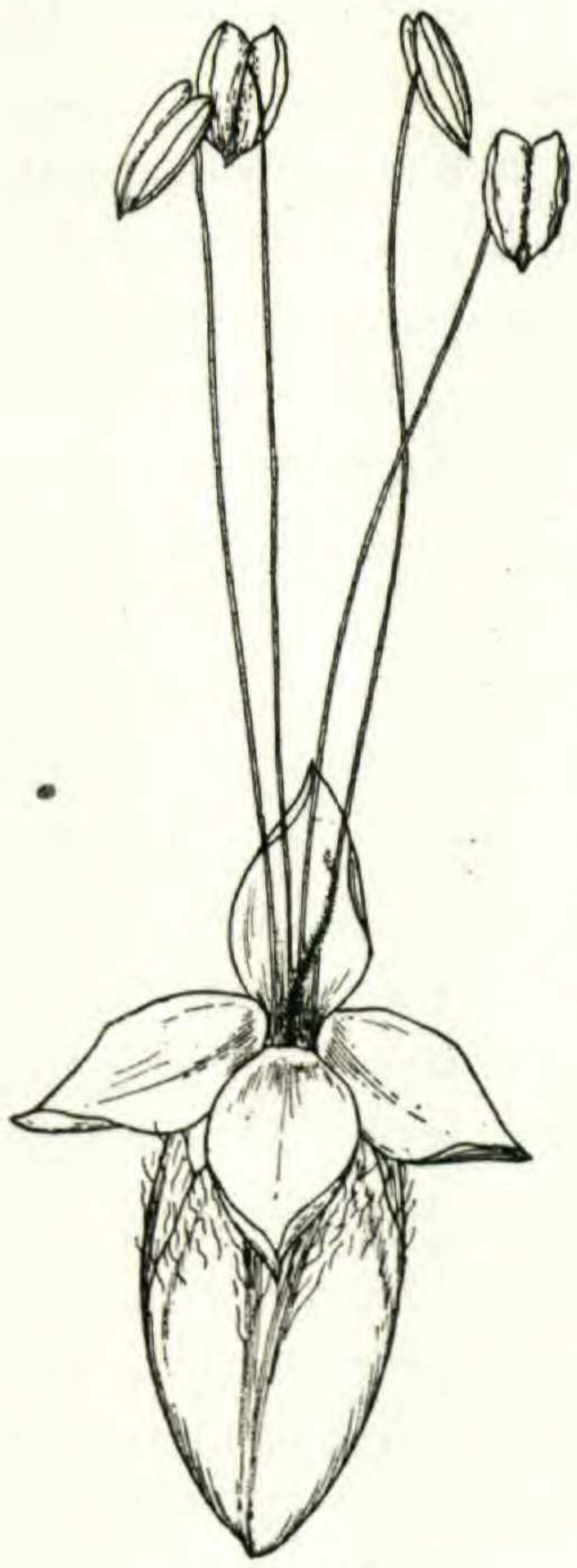

Fig. 1. Plantago lanceolata. Flower of 1st form hermaphrodite.

1st Form Hermaphrodite. This is the form shown in fig. 1. Typically the filaments are about four times as long as the stigma. The anthers are white, and twice as long as broad. The pollen is very abundant.

2d Form Hermaphrodite. A flower from the plant found at Bethesda, Md., is shown in fig. 2. The filaments and style are of equal length, and about half as long as the filaments of the 1st form. The anthers are four times as long as broad, and yellow. The pollen is more scanty than in the 1st form, and, on account of the irregular dehiscence of the contabescent anthers, is not usually liberated. Pollen grains of uniform size, diameter half as great as in the 1st form.

Pistillate Form. Shown in fig. 3. Filaments so short that the abortive, brownish anthers are hardly or not at all exserted. Stigma usually longer than in the 2d form hermaphrodites.

Pistillate forms vary greatly in the extent to which the stamens are developed. Some of them differ from the 2d form hermaphrodite only in the fact that the anthers are greener, and contain no pollen. In others the stamens are represented only by minute scales. In some pistillate types very few of the flowers ever open. The stigmas are extruded as usual, but the perianth never expands. In others the flowers open in the normal way.

Fig. 2. Plantago lanceolata. Flower of 2nd form hermaphrodite.

Both the 2d form hermaphrodite and the pistillate form show much variation in the length of the stigma. When the original plant of the 2d form hermaphrodite was found, its stigmas

were exceedingly long and plumose, so that the spikes looked like bearded wheat. This extreme condition was temporary, however, for as soon as the 1st form hermaphrodites in the fields commenced to yield plenty of pollen, the stigmas did not grow so long. Yet the character of long stigmas is by no means altogether circumstantial. It is often seen in pistillate plants which are growing in colonies where pollen is abundantly available. It may likewise be shown to occur rarely in the 1st form hermaphrodite, and more commonly in the gynomonoecious types, by examining the length which the stigmas attain before the lowermost flowers of a spike mature their stamens. On the other hand, pistillate types occur in which the stigmas are very short indeed. The long- or short-stigma character may occur in combination with any set of stamen characters.

All the seed matured by the original plant of the 2d form hermaphrodite found in 1910 were saved and planted. No effort was made to guard pollination. Doubtless the stigmas were pollinated by the 1st form hermaphrodite, for the plumose styles of one spike were examined and found to be amply supplied with the large pollen of the 1st form while the anthers of the 2d form were drying up without having dehisced.

The seed were planted in four lots:

1st lot. 25 seeds from the first three spikes to mature, planted in August in unsterilized garden soil taken from below the surface. Plants 1 to 9.

2d lot. Seed from the last three spikes to mature. If there were any self-pollinated seed (which is very improbable) they would have been in this lot, for at the time the spikes flowered the mother plant was isolated in the green-house, and there were very few plants in bloom out doors. Planted in October in clean white sand.— 17 plants, nos. 10 to 26.

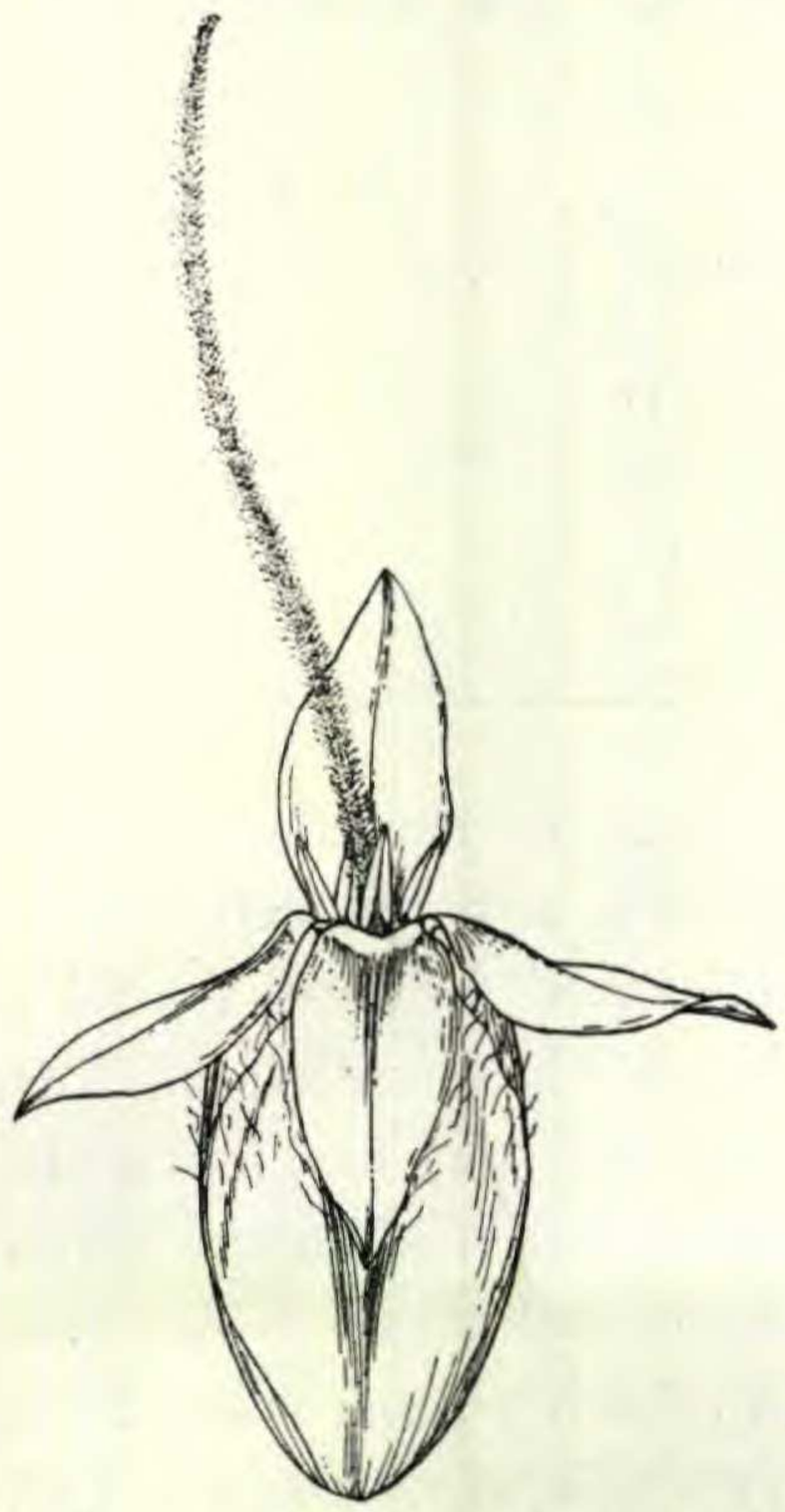

Fig. 3. Plantago lanceolata. Flower of pistillate form.

3d lot. Seed from spikes which flowered in the garden during the

height of the season. Planted in December in sterilized soil.— 45 plants, nos. 27 to 71.

4th lot. Remaining seed from the first three spikes, planted in February in sterilized soil.— 66 plants, nos. 72 to 137.

The first three lots were twice repotted, and were never set out in the garden. The fourth lot were set out in the garden early in the spring. Details of the planting are recorded because some of the plants will be grown another generation, and reported upon next year. The results of growing the first generation are chiefly of interest in that they show how the characters of such a derivative as the 2d form hermaphrodite might maintain themselves in nature, without isolation or selection.

The progeny were readily classified, with a few exceptions which will be discussed later, as typical hermaphrodites of the 1st and 2d forms. The numbers of the two types were as follows:

Lot	1st Form.	2d Form.	Unclassified	Total.
I.	6	2	1	9
II.	7	10	0	17
III.	17	20	8	45
IV.	21	41	4	66
All.	51	73	13	137

None of the plants classified as 1st and 2d form hermaphrodites showed any marked deviation in anther character from the types illustrated in figs. 1 and 2. There were, however, several plants among those called 2d form which had the typical anthers of this form but long filaments, and one plant with unusually green anthers. These will be grown for another generation. The 13 unclassified plants included 7 which formed vigorous rosettes, but did not flower, and 6 with short rounded spikes. The mother plant had long spikes (var. *alopecurodes* F. Ludwig). Short-spiked plants of *Plantago lanceolata* have been set off as a variety (var. *sphaerostachya* DC.) which is not generally maintained as valid, for most systematists would probably regard it, *a priori*, as a mere ecological state. In my cultures, however, a short-spiked variety was sharply set off from a long-spiked variety, although both were grown under identical conditions. The short-spiked plants had some white stamens, but could

not be classed with the 1st form hermaphrodites on account of their strong gynomonoecious tendency.

In vegetative characters the culture showed extreme diversity. One plant was the most narrow-leaved specimen of the species which the writer has thus far seen. Other plants showed almost maximum leaf breadth. (The mother was rather narrow-leaved.) In some of the progeny the leaves were prominently serrate, in others nearly entire. In pubescence, length of stigmas, shape of perianth parts, and development of anthocyanin there was no uniformity. There seemed to be no correlation of these characters with one another, except that perhaps narrow leaves were usually correlated with narrow perianth parts, and that 2d form hermaphrodites were never very broad-leaved. On the other hand, many narrow-leaved plants, including the exceptional one mentioned above, were of the 1st form.

Seed from a purely pistillate plant of *Plantago lanceolata* were also harvested in the fall of 1910 and planted in a cold frame in sterilized soil. Unfortunately there was no room to pot the young plants, so that when they became over-crowded they had to be set out in the garden directly from the seed pans. A late frost destroyed all but a few of four hundred plants. The remainder, in bloom, were either like the mother (purely pistillate) or the usual 1st form hermaphrodite. The numbers of each type were not counted, however. The culture will be repeated next year.

Correns has made a study of heredity in many gynodioecious plants. In those of his papers [1] which deal with *Plantago lanceolata* he has reported on the progeny of 28 plants whose pollination was unguarded, and four plants whose pollination was guarded. All of his mother plants seem to fall into the following categories: 1) pure 1st form hermaphrodites, 2) gynomonoecious types with a) some functional stamens, or b) all of the anthers contabescent, and 3) purely pistillate types. His tabulated results show that the progeny of all except certain of the pure hermaphrodite stocks included pure pistillates, and even in the case of one of the pure hermaphrodites, the pure pistillates amounted to 50%. Since in counting pure pistillate stocks,

[1] Correns: Die Vererbung der Geschlechtsformen bei den gynodiöcischen Pflanzen. Ber. d. deutsch. bot. Ges. xxiv (1906) pp. 459–474.

—— Zur Kenntnis der Geschlechtsformen polygamer Blütenpflanzen und ihrer Beeinflussbarkeit. Jahrb. f. wiss. Bot. xliv (1907) pp. 124–173.

—— Die Rolle der männlichen Keimzellen bei der Geschlechtsbestimmung der gynodiöcischen Pflanzen. Ber. d. deutsch. bot. Ges. xxvi a (1908) pp. 683–701.

Correns excluded all plants with contabescent anthers,[1] it is of interest that the 2d form hermaphrodite, with contabescent anthers only, should (with one possible exception) give no progeny more closely approximating the pistillate form than itself. It is furthermore noteworthy that there should be 2d form hermaphrodites among the progeny with typical anthers but with filaments long and straight, as in the 1st form, and that these should have but one type of flower, (i. e. should show no tendency toward gynomonoecism.)

Neither out-door observations of wild plants nor garden and greenhouse cultures sustain Ludwig's statement that the pistillate plants of *Plantago lanceolata* flower later in the season than the hermaphrodites. After the height of the flowering season has passed, pistillate stocks seem unusually abundant because the continued growth of the unpollinated stigmas makes them unusually conspicuous. Then too, gynomonoecious types often have only pistillate flowers at the tops of the spikes, and late in the season might be carelessly classified as pure pistillates.

BUREAU OF PLANT INDUSTRY, Washington, D. C.

THE RANGE OF THE BLACK BIRCH TO BE RESTRICTED.— In all the manuals of botany and tree books where it is treated we are assured that the black birch, *Betula lenta*, often called the sweet birch and cherry birch, ranges east to Newfoundland. But in fact its eastern limit is close to the eastern boundary of New Hampshire, and a line drawn from Portland, Maine, to Montreal will mark its eastern and northern limit at least in the United States. The only places in Maine where I have seen it are in the Piscataqua valley, and the only specimens I have seen from Maine grew there. Specimens labeled as black birch are found from places farther east but the most cursory examination shows them to be incorrectly named. I have botanized in all of the Maritime Provinces and in Newfoundland, and found as I expected that there was no such tree there.

The provincial botanists having never seen the real black birch think that when they find a yellow birch (*B. lutea* L.) with black bark

[1] "Rein gefüllt blühende Stöcke, bei denen die Staubgefässe in Füllblätter verwandelt sind, sind [als rein weibliche Pflanzen] eingerechnet, solche mit lauter kontabeszenten Antheren jedoch nicht, obwohl sie physiologisch auch rein weiblich sind." Ber. d. d. bot. Ges. xxvi a (1908) p. 691.